

InterICE

Ice core storage facilities at LGGE, Grenoble, France

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The Laboratoire de Glaciologie et Géophysique de l'Environnement (LGGE-CNRS) started by the 70's, to deal with ice core and set storage facilities as deep ice core technology was developed. This corresponds to the time of the new clean room technologies became available and used for ice core processing, the analytical methods allows measurements en routine of stable isotope content of water, the low level of radioactivity, and the very low content of chemical elements and heavy metals among others in the ice.

First drilling tests have been conducted by LGGE, in Antarctica in 1972, using a thermal drill system. Follows a first 905 m deep ice core retrieved at Dome C in 1978. Since, LGGE upgraded the thermal drilling systems and conducted several tests as well as performed several electromechanical shallow cores at various locations. The collaboration with the Soviets started by 1980's, and a series of samples from Vostok, Dome B, Komsomorskaya as well as along the Mirny-Vostok route have been collected and studied. Since 1990's the international collaboration continued with Russia and USA for Vostok, and the European nations with Eurocore, then GRIP, in Greenland and now with EPICA Dome C and Droning Maud in Antarctica. At the same time, various snow collections have been made from pits samplings and from hand drilled shallow cores. All the ice cores and pits samples have been transported from field in variable type (insulated metallic or cardboard boxes, insulated shipping container, ...) and size of insulated boxes.

In fact, LGGE accumulated in cold rooms a variety of ice cores having different diameters, variable lengths variable qualities, along with a series of various boxes from surface collections. Also ice cores

are generally kept for storage as archive even a long time after completion of their study. This because advances in technique may allow measurements of new parameter of interest.

LGGE used two places for storages. One is for short-term storage, a few weeks or month, and is represented by a set of specific cold rooms inside the main building and close to laboratories where ice core are processed. The second type of storage is an area rented in a commercial warehouse and used for the long term storage.

The long term storage is rented from private company in charge of storage of frozen food products such as meat, cheese, vegetables... Two areas are used representing a total of 210 rooms for pallets (1m*1.2m*1.8m) capability. One contains 130 pallets, the second 80 pallets, and both are part of a room having a 500 pallets total capability.

The mean temperature is kept at -22°C , and this temperature is in agreement with policy for long term storage for food. However, this temperature may fluctuate with the working time as well as the cycles of defrosting, so that amplitude may reach up to 4°C for a few hours.

The storage in this type never failed in almost 30 years of use. A permanent survey 365 day a year, a double machinery for each chamber, and a back up with other rooms contribute to this safety.

For 2003, the fare for rental is 65 K€ /annum that represents an average fare of 25 €/month per pallet. This fare is supported only by CNRS (budget for infrastructure i.e. building).

On each pallet rests a set of boxes (4 to 6 depending on size and weight up to 60 kilos) containing the samples from various origin are just stacked. Each box is identified by a label with the content, the owner's name (a reference person or scientist LGGE) as well as the location of the pallet in the chamber.

Ice core sections of substantial size (a least representing one kilo of ice) are sealed in plastic bag and are placed in cardboard tubes. A frame in metal is fixed to the pallet and receive 55 cardboard tubes (1.10m long, inside diameter 12.5 cm). The tubes are lay over to

make a kind of tube-wall (10 rows of 5 or 6 tubes). Two panels each side of the frame allow to close the tubes. Tubes are labelled (pallet number, row, column) and this allows a quick access to the ice samples.

Recently, LGGE received ice core boxes from EPICA ice core for laboratory and a part to be stored as an archive for future studies. The ice core samples are generally 55 cm long, and the archive represents about one fourth of the core. All cores fit the boxes (50cm*75cm*75 cm) and one box may contain from 30 - 80 different samples and weigh up to 80 kilos. An area was set in one room and each box can be accessed from the shelves where they are placed by using a manual mobile lift.

The curation of the ice core samples is generally the responsibility of each research scientist who is in charge of a programme (reference person). For EPICA ice core, the Science Steering Committee is the official owner and the allocation of ice samples, which are transmitted to the curator (G. Teste from LGGE) for execution and updating the ice core list.

As a summary, the ice core collection of LGGE is significant in terms of volume of ice (120 pallets with tubes (6000 tubes), 450 boxes in total) and in terms of activity for curation. Grenoble is 100 km from Lyon international airport accessible directly from major city but may require a stop in Paris for some other city. This has to be taken into account for the time of transport for delivery of ice cores.

Renting area of a warehouse is expensive but this provides an almost 100% requested security for long-term storage. The temperature of the storage may be a concern. The physical properties of the ice are altered because ice relaxes more rapidly as temperature is over -40°C . Also the cycles of temperature (defrosting) may produce sublimation of the ice and condensation as snow inside the plastic bag of the ice core. Time and temperature cycling may also alter content of some chemical content of the ice such as MSA, but the process is not yet established.

The way for storage in boxes on pallets, on shelves, or in tubes, has their own advantages and drawbacks. Storage in closed tubes, or better in insulated box should limit temperature variation and ice sublimation.

Long term storage of archives of ice cores in station inland Antarctica (South Pole, Vostok, the future Concordia station) where mean temperature is close to -50°C offer some advantage in this respect.